

# **TOPEX Side B Sigma0 Calibration Table Adjustments: September 2001 Update**

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## **Introduction**

The TOPEX Altimeter Calibration Parameter Table, referred to as the Cal Table in the following, includes predicted updates for future cycles. At the Wallops Flight Facility of NASA's Goddard Space Flight Center we monitor trends in quantities related to the TOPEX altimeter's return power estimation and we propose, as appropriate, changes to the Cal Table. This memo describes changes we proposed in September 2001. Those changes were made by JPL (under the control of MCR #740 of 25 September 2001) based on a preliminary version of this memo. Following sections of this memo will provide a brief review of Cal Table history, will show the Side B trends in power-related quantities, and then will describe a trend fit using three linear segments that will be the basis for a new set of Cal Table sigma0 correction update values.

## **Review of Cal Table History**

Before launch we had expected that the Calibration Mode 1 AGC would be the basis for Cal Table updates, but the Cal Mode AGC trend differed sufficiently from the over-ocean sigma0 cycle averages that we chose to base Side A Cal Table updates on the trend in the sigma0 cycle averages. Because the Cal Table corrections have already been applied to the sigma0 in the distributed GDR (Geophysical Data Record), it is important to remove these Cal Table corrections from the data before doing the trend assessment. All the sigma0 trends discussed here are after the Cal Table corrections have been removed. Basing the sigma0 correction on the trend of the uncorrected sigma0 itself is highly incestuous, and we tried only to make the corrections on the basis of relatively long-term trends. The TOPEX Side A history is discussed in a note "TOPEX Sigma0 Calibration Table History for All Side A Data", by G.S. Hayne and D.W. Hancock III, 27 July 1999, available at [http://topex.wff.nasa.gov/docs/Sigma0Cal\\_A\\_All.pdf](http://topex.wff.nasa.gov/docs/Sigma0Cal_A_All.pdf).

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After the switch to Side B operation at the start of cycle 236, we observed that the Side B Cal Mode AGC trend did appear to follow the trend of the sigma0 cycle averages. From the start of Side B operation until now, the Side B Cal Table updates have been based on the Cal Mode AGC trend. The Side B history is discussed in “TOPEX Side B Sigma0 Calibration Table Adjustments: February 2001 Update”, by G.S. Hayne and D.W. Hancock III, 15 February 2001, available at [http://topex.wff.nasa.gov/docs/Sigma0Cal\\_B\\_Feb2001.pdf](http://topex.wff.nasa.gov/docs/Sigma0Cal_B_Feb2001.pdf). The Cal Mode AGC trends for both Ku- and C-band have appeared relatively flat for the last thirty cycles or so, and no Cal Table sigma0 changes have been made since cycle 305.

### **Current Side B Trends of Power-Related Quantities**

Figure 1 plots the cycle-averages of Side B Ku-band power-related quantities. These have been shifted by amounts given in the figure legend, so that all can be plotted on the same vertical axis for time trend comparison. There has been a small seasonal correction applied to the sigma0 cycle averages; this empirical correction is based on the Side A sigma0 data. The seasonal correction reduces slightly the vertical scatter of the sigma0 cycle averages, but does not change the overall trend of these data. In Figure 1 the Side B Ku-band sigma0 trend continues to agree quite well with the Calibration Mode AGC trend through cycle 329, the last complete data cycle included in this analysis.

Figure 2 is the Side B C-band counterpart of the Ku-band Figure 1. Notice in Figure 2 that the Side B C-band sigma0 trend has recently shown some apparent departure from the C-band Cal Mode AGC trend. This departure is more or less linear in time over the last forty cycles, with the C-band sigma0 now being about 0.1 dB lower relative to the AGC.

As we were forced to do for the Side A Cal Tables, it now seems necessary to make new C-band Cal Table updates based on the sigma0 cycle averages rather than the Cal Mode AGC. The new Ku-band Cal Table updates will also be based on sigma0 cycle averages so that we have a consistent procedure for both Ku- and C-band Cal Table updates.

### **Line Segment Fits to Side B Sigma0 Trends**

There was a spacecraft safe hold for most of cycle 256, and the Ku-band Cal mode AGC and sigma0 cycle averages showed an apparent change after the safe hold. The C-band showed much less change, if any, after the safe hold. We have decided to assume a possible discontinuity in performance of both the Ku- and C-band systems at cycle 256, and to fit both the Ku- and C-band Side B sigma0 cycle averages (seasonally-corrected) from cycles 236 - 255 by single straight-line segments.

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For the data from cycles 257 - 329, it was arbitrarily decided to fit the sigma0 cycle averages by a function consisting of two connected straight-line segments. This fitting function will be continuous in value, but will have a discontinuity in slope, and we let the least-squares fitting process pick the time (or cycle) location of the discontinuity.

The results of the sigma0 trend fitting are shown in Figure 3, in which both the sigma0 cycle averages and the trend fits have been plotted relative to their cycle 237 values; the shift to cycle 237 values is for convenience to allow both the Ku- and C-band data and fits to be plotted on a single vertical axis.

### **New Sigma0 Correction Values for Cal Table**

Starting with the fitted sigma0 trends shown in Figure 3, the inverse of these trends will be used for the Cal Table updates. Figure 4 shows the Ku-band old and new Cal Table values. This figure may be slightly misleading in its plotting an “old” Cal Table value for each cycle; actually the Cal Table entries list only the changes in sigma0 calibration. Until the analysis reported in this memo, the last change in Ku-band sigma0 Cal Table entry was at the start of cycle 300, and that value has “on hold” for processing of cycles 300 through 326. The new values are the cycle by cycle values on the straight line segments labeled “new Ku-band Cal Table” in the figure. One additional adjustment to the new Cal Table values is to impose a 0.03 dB quantization on the Cal Table updates. This is the same quantization that has been used in all of the TOPEX Cal Table entries to date, and the quantized new Ku-band Cal Table values are shown by the open triangles plotted in Figure 4. The new quantized Ku-band Cal Table values are listed in Table 1.

Figure 5 shows the C-band old and new Cal Table values, and the new quantized C-band Cal Table values are also listed in Table 1. Until the analysis reported here, the last “old” C-band Cal Table change was at cycle 305, with that value being held for processing cycles 305 through 326. Table 1 provides new Cal Table values out through cycle 375, with the values for cycles greater than 329 having been obtained by simple extrapolation of the rightmost fitted straight-line segments in Figure 3.

The TOPEX cycle 327 began on 30 July of this year (2001 day 211). Since the cycle 327 GDR had not been distributed at the time of this analysis (in mid-September 2001), we recommended using the new Cal Table values of this memo beginning with cycle 327. Figures 1, 2, 4, and 5 indicate the new values having been applied to distributed GDRs beginning with cycle 327. Although Table 1 has given new quantized Cal Table values through cycle 375, it is likely that an additional Cal Table adjustment will have to be made before the time of cycle 375.

**Table 1. TOPEX Side B Sigma0 Cal Table Values, in dB**

<b>TOPEX Data Cycle</b>	<b>Ku-band Cal Table Value Used for GDR</b>	<b>C-band Cal Table Value Used for GDR</b>	<b>New Ku-band Cal Table value</b>	<b>New C-band Cal Table value</b>
236	0.45	0.55	0.45	0.52
237	0.45	0.55	0.45	0.52
238	0.45	0.55	0.45	0.55
239	0.45	0.55	0.45	0.55
240	0.45	0.55	0.45	0.55
241	0.45	0.55	0.45	0.55
242	0.45	0.55	0.45	0.55
244	0.45	0.55	0.45	0.58
245	0.45	0.55	0.45	0.58
246	0.45	0.55	0.45	0.58
247	0.45	0.55	0.45	0.58
248	0.45	0.61	0.45	0.61
249	0.45	0.61	0.45	0.61
250	0.45	0.61	0.45	0.61
251	0.45	0.61	0.45	0.61
252	0.45	0.61	0.45	0.61
253	0.45	0.64	0.45	0.64
254	0.45	0.64	0.45	0.64
255	0.45	0.64	0.45	0.64
257	0.45	0.64	0.36	0.64
258	0.45	0.64	0.36	0.64
259	0.27	0.64	0.33	0.64
260	0.27	0.64	0.33	0.64
261	0.27	0.64	0.30	0.64
262	0.24	0.64	0.30	0.64
263	0.24	0.67	0.30	0.64
264	0.24	0.67	0.27	0.64
265	0.24	0.67	0.27	0.64
267	0.21	0.67	0.24	0.64
268	0.21	0.67	0.24	0.64
269	0.21	0.67	0.24	0.64
270	0.18	0.70	0.24	0.64
271	0.18	0.70	0.24	0.64
272	0.18	0.70	0.24	0.64
273	0.18	0.70	0.24	0.64
274	0.15	0.70	0.24	0.64
275	0.15	0.70	0.24	0.64
276	0.15	0.70	0.24	0.64
277	0.21	0.58	0.24	0.64
279	0.21	0.58	0.24	0.64
280	0.21	0.58	0.24	0.64
281	0.21	0.58	0.24	0.64
282	0.21	0.58	0.24	0.64
283	0.21	0.61	0.24	0.64
284	0.21	0.61	0.24	0.64
285	0.21	0.61	0.24	0.64
286	0.21	0.61	0.24	0.64

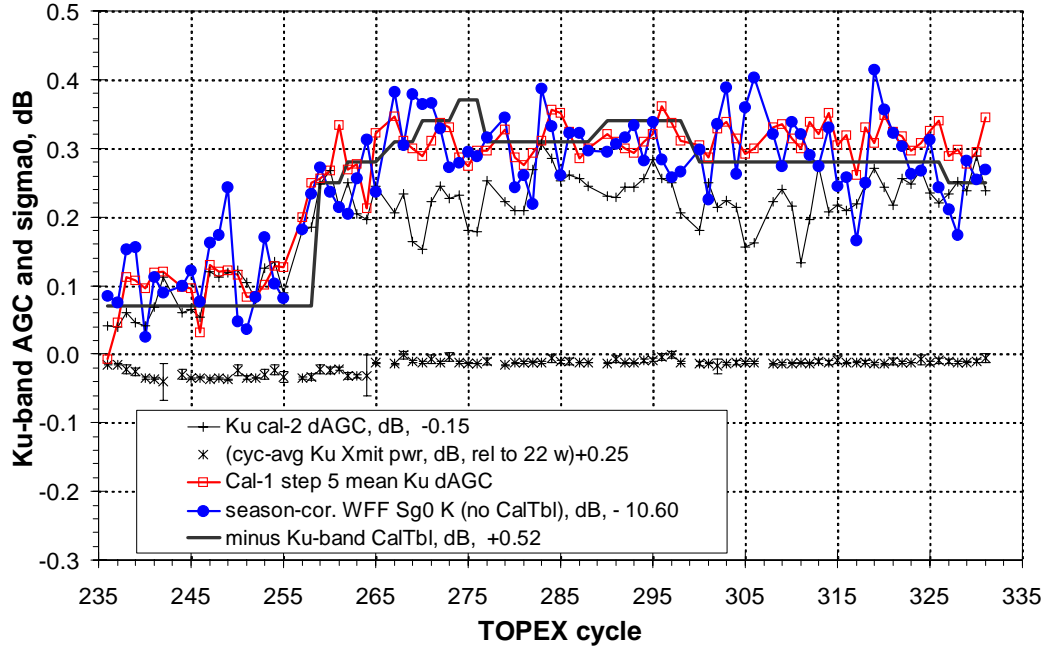
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<b>TOPEX Data Cycle</b>	<b>Ku-band Cal Table Value Used for GDR</b>	<b>C-band Cal Table Value Used for GDR</b>	<b>New Ku-band Cal Table value</b>	<b>New C-band Cal Table value</b>
287	0.21	0.61	0.24	0.64
288	0.21	0.61	0.24	0.64
290	0.18	0.61	0.24	0.64
291	0.18	0.61	0.24	0.67
292	0.18	0.61	0.24	0.67
293	0.18	0.61	0.24	0.67
294	0.18	0.61	0.27	0.67
295	0.18	0.61	0.27	0.67
296	0.18	0.61	0.27	0.67
297	0.18	0.61	0.27	0.67
298	0.18	0.61	0.27	0.67
300	0.24	0.61	0.27	0.67
301	0.24	0.61	0.27	0.67
302	0.24	0.61	0.27	0.67
303	0.24	0.61	0.27	0.70
304	0.24	0.61	0.27	0.70
305	0.24	0.64	0.27	0.70
306	0.24	0.64	0.27	0.70
308	0.24	0.64	0.27	0.70
309	0.24	0.64	0.27	0.70
310	0.24	0.64	0.27	0.70
311	0.24	0.64	0.27	0.70
312	0.24	0.64	0.27	0.70
313	0.24	0.64	0.27	0.70
314	0.24	0.64	0.27	0.70
315	0.24	0.64	0.27	0.73
316	0.24	0.64	0.27	0.73
317	0.24	0.64	0.27	0.73
318	0.24	0.64	0.27	0.73
319	0.24	0.64	0.27	0.73
320	0.24	0.64	0.27	0.73
321	0.24	0.64	0.27	0.73
322	0.24	0.64	0.27	0.73
323	0.24	0.64	0.27	0.73
324	0.24	0.64	0.27	0.73
325	0.24	0.64	0.27	0.73
326	0.24	0.64	0.27	0.73
327	0.27	0.76	0.27	0.76
328	0.27	0.76	0.27	0.76
329	0.27	0.76	0.27	0.76
330	0.27	0.76	0.27	0.76
331	0.27	0.76	0.27	0.76
332	0.27	0.76	0.27	0.76
333	0.27	0.76	0.27	0.76
334	0.27	0.76	0.27	0.76
335	0.27	0.76	0.27	0.76
336			0.27	0.76
337			0.30	0.76
338			0.30	0.79
339			0.30	0.79
340			0.30	0.79

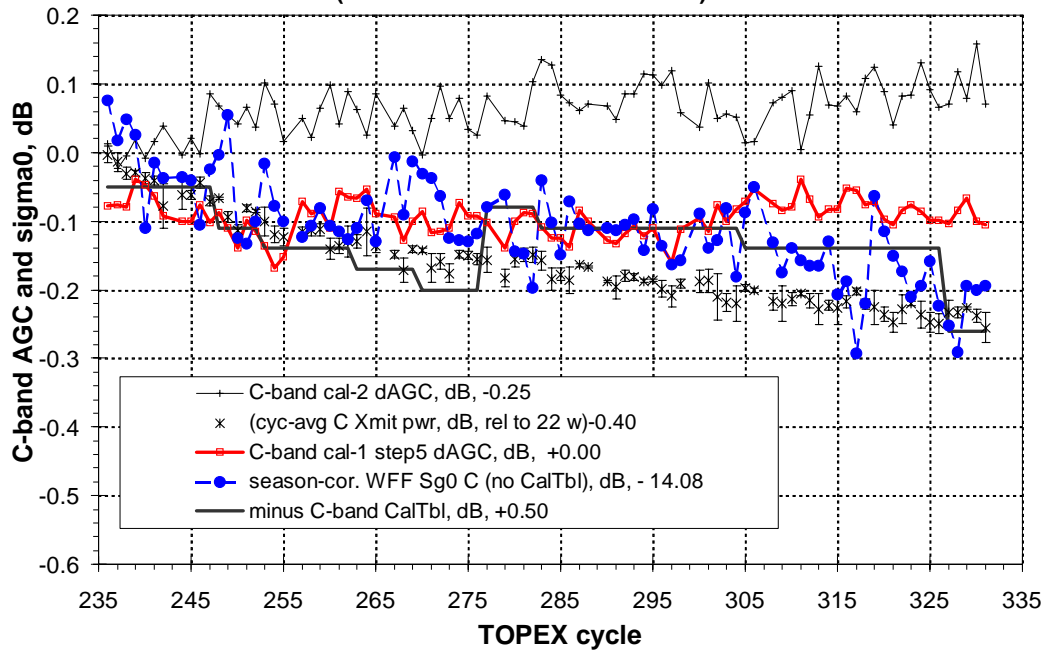
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<b><i>TOPEX Data Cycle</i></b>	<b><i>Ku-band Cal Table Value Used for GDR</i></b>	<b><i>C-band Cal Table Value Used for GDR</i></b>	<b><i>New Ku-band Cal Table value</i></b>	<b><i>New C-band Cal Table value</i></b>
341			0.30	0.79
342			0.30	0.79
343			0.30	0.79
344			0.30	0.79
345			0.30	0.79
346			0.30	0.79
347			0.30	0.79
348			0.30	0.79
349			0.30	0.79
350			0.30	0.82
351			0.30	0.82
352			0.30	0.82
353			0.30	0.82
354			0.30	0.82
355			0.30	0.82
356			0.30	0.82
357			0.30	0.82
358			0.30	0.82
359			0.30	0.82
360			0.30	0.82
361			0.30	0.82
362			0.30	0.85
363			0.30	0.85
364			0.30	0.85
365			0.30	0.85
366			0.30	0.85
367			0.30	0.85
368			0.30	0.85
369			0.30	0.85
370			0.30	0.85
371			0.30	0.85
372			0.30	0.85
373			0.30	0.85
374			0.30	0.88
375			0.30	0.88

**Figure 1. Ku Side B Cycle-Avg Cal-1 & Cal-2 Delta AGC, Sigma0  
(Cal Table Corrections Removed)**



**Figure 2. C-Band Cycle-Avg Cal-1 & Cal-2 Delta AGC, Sigma0  
(Cal Table Corrections Removed)**



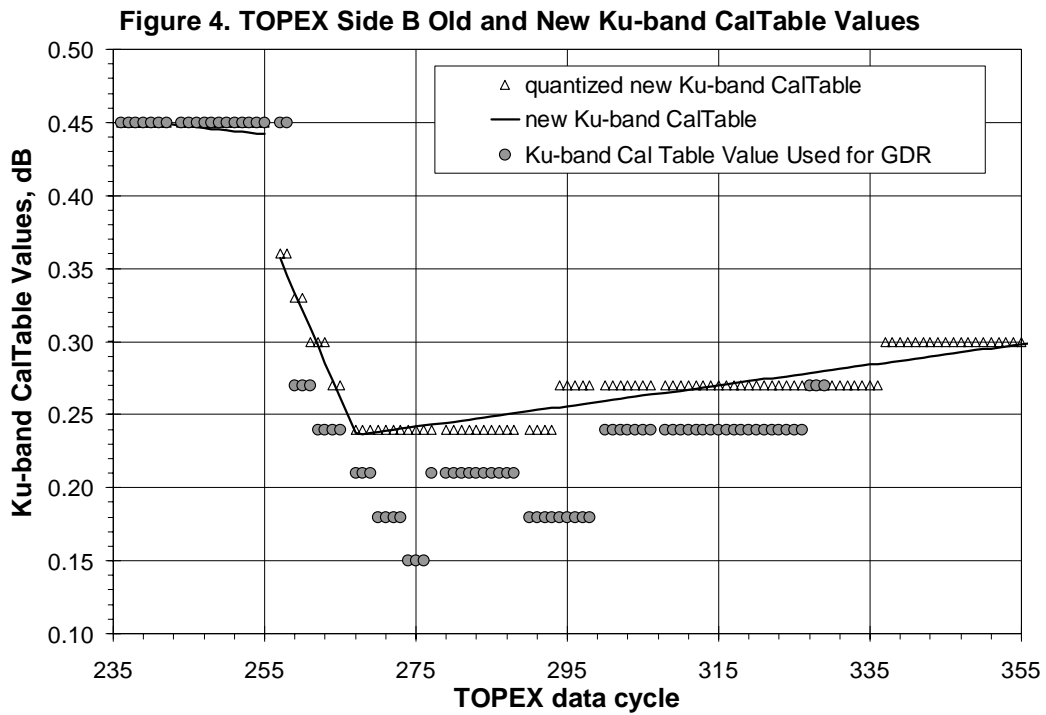
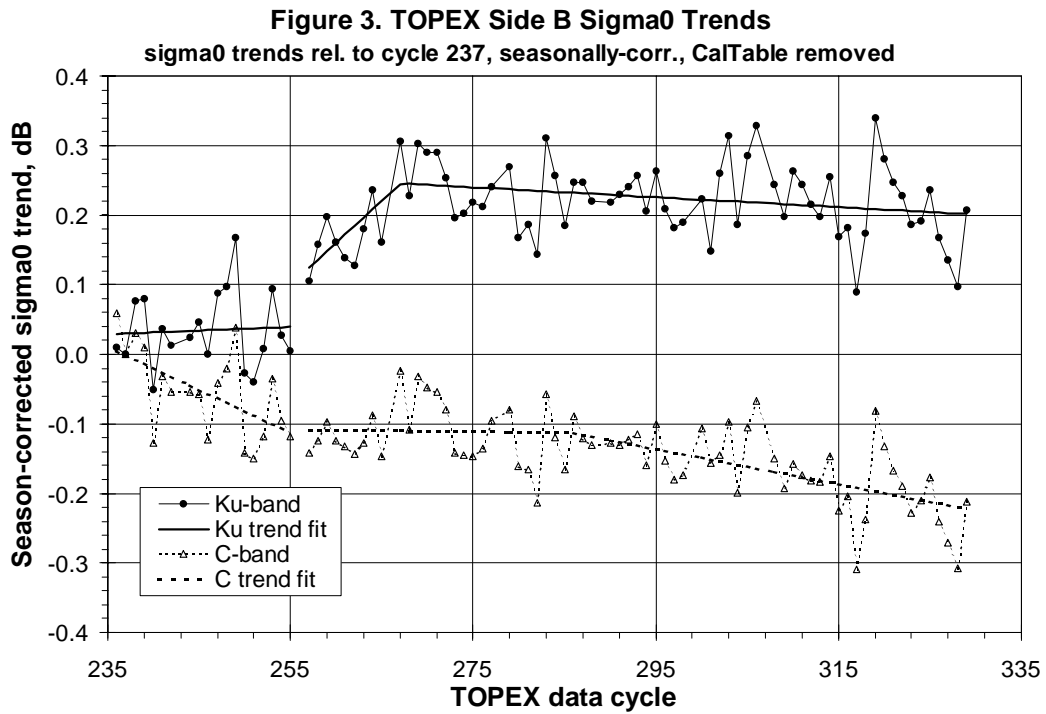


Figure 5. TOPEX Side B Old and New C-band CalTable Values

